

# NORTHERN IDAHO GROUND SQUIRREL DIET STUDY INTERIM REPORT OF THE 2008 PILOT FIELD EFFORT

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## BACKGROUND

The northern Idaho ground squirrel (*Spermophilus brunneus brunneus*; NIDGS) Technical Working Group has, for a number of years, recognized the need for a comprehensive study of NIDGS diet. This fundamental aspect of NIDGS ecology is critical to understanding population decline, assessing the extent of competition with livestock, and identifying important forage plants for habitat restoration projects. One previous study comparing diets of NIDGS and Columbian ground squirrels (*S. columbianus*) was incomplete, sampling from 2 sites (Huckleberry and Cold Springs) during a 1-week period in 1 year (Dyni and Yensen 1996). A second study on the nutritional content of forage plants had a different emphasis, examining the nutritional values of plants potentially important to NIDGS and comparing nutritional values among sites with different management histories (Yensen 2004). That study originally focused on 15 plant species and sampled from 4 occupied sites the first year, then refocused to fewer plants and 1-2 sites (Summit Gulch and Tree Farm) the following 2 years. While these studies generated important information, they were not representative of the diversity of occupied sites or the full spectrum of plants available from emergence through hibernation. A comprehensive research study of what NIDGS eat throughout the active season remains a recovery priority.

In 2007, with funding from the Payette National Forest, the Technical Working Group tasked Dr. Eric Yensen with developing 2 study proposals, 1 of which focused on diet and potential overlap with livestock. The resulting study design called for sampling at 5 occupied NIDGS sites, 5 times per year per site for 2-3 years (Yensen 2008). The Idaho Department of Fish and Game implemented a pilot year of sampling at Tree Farm and Summit Gulch during the 2008 field season.

## METHODS

*Plant Specimens* —Plants eaten by NIDGS are identified through laboratory analysis of fecal pellets. The Laboratory compares cell structure and features of plants eaten by squirrels to plant reference slides. Our objective was to record every plant species present and collect 2 specimens of each at Tree Farm and Summit Gulch for reference slides and for herbarium voucher specimens. We divided the Tree Farm site into 9 sections to systematically cover the site. Plants were recorded by section and specimens were pressed and later catalogued. At Summit Gulch we recorded presence of all plants encountered but collected only specimens not detected at Tree Farm. We continued recording and collecting new plants as they were encountered through 21 July.

We modified the study design to incorporate a ‘plant availability’ component. The objective was to sample vegetation composition and cover along 100-m transects during the same periods that fecal pellets were collected. The general locations of transects were established a priori on aerial photos

to ensure adequate distribution across the site, but the specific starting points and directions were random. We placed a 20 x 50 cm Daubenmire frame ('quadrat') every 10 m along each 100-m transect (each time randomly selecting which side of the transect line the frame was placed) and recorded an ocular estimate of ground cover for classes (e.g., bare ground, grasses, forbs, shrubs) and an estimate of canopy cover for each species observed. Species composition, total cover, and frequency of encounter were summarized from these data (Bureau of Land Management 1999).

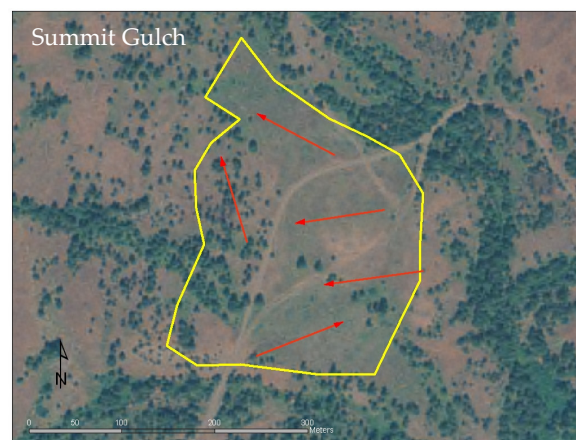
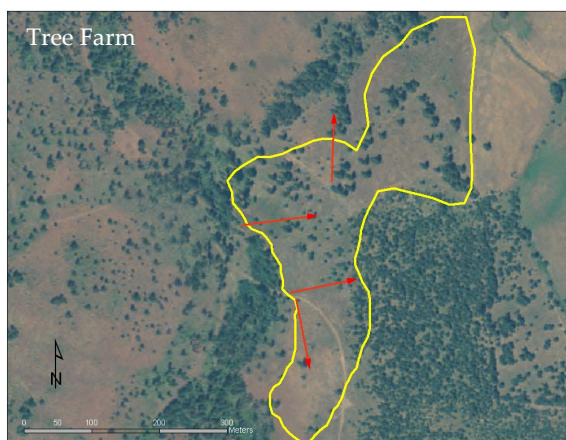
*Fecal Pellets* —Fecal sampling was designed to occur in conjunction with IDFG's ongoing population monitoring. Specifically, squirrels live-trapped as part of long-term mark-recapture efforts (Evans Mack 2004) were held a little longer before release to obtain a fecal sample. Samples were placed in vials in a 70% ethanol solution. IDFG typically traps adults and yearlings during April and May. Additional trapping sessions were added at the 2 study sites in June and July solely to obtain fecal samples during these months. Juveniles had emerged by this time and were included in the target group. Cow samples were collected during the July sampling period. Fecal pellets were submitted to the Washington State University's Department of Natural Resources, Wildlife Habitat Nutrition Laboratory for analysis.

## RESULTS

The first plant collection occurred on 21 and 23 May at Tree Farm. The species list for this site and Summit Gulch continued to be developed through 21 July. In all, 140 plants (including unknowns) were recorded for the 2 sites (Table 1). The collected specimens were examined by Payette National Forest botanist Alma Hanson, with assistance from Marilyn Olson, for species confirmation. The collection was then sent to Dr. Yensen and Pat Packard (retired botanist and herbarium curator), College of Idaho, to identify remaining unknowns and prepare voucher specimens.

Our identification skills were weak for grasses, sedges, and rushes. Several grasses were collected during the first visit at Tree Farm before they had flowered. Many of the early-flowering forbs were gone before we surveyed Summit Gulch, and we did not do as complete a walk-through compared with Tree Farm, so likely more species occur at Summit than the list reflects. In a following year, an earlier survey is needed at both sites, as well as more attention to shrubs and graminoids.

Only 1 Daubenmire vegetation sampling survey was completed at each site, and the respective dates fell mid-way between fecal pellet sampling. Four 100-m transects (40 frames) were completed at Tree Farm on 10 June; 5 transects (50 frames) were completed at Summit Gulch on 23/24 June.





The 2 sites differed floristically. The most frequently encountered species at Tree Farm were a tiny unidentified plant, yarrow, cinquefoil, larkspur, buckwheat, pussytoes, wetland scenecio, blue-eyed Mary, 2 species of *Lomatium* (bisquitroot and nine-leaved), and wild strawberry (Table 2). Most of these also had the highest canopy cover, with the addition of snowberry.



The most frequently encountered species at Summit Gulch were *Collomia sp.* & *Microsteris sp.* combined, 3 grasses, buckwheat, yarrow, white wyethia, and blue-eyed Mary. Buckwheat had the highest cover, followed by 1 of the unidentified grasses, lupine (non-fuzzy), prairie smoke, and the combined *Collomia sp./Microsteris sp.* (Table 3).

We collected NIDGS fecal samples in May and July from Tree Farm, and June and July from Summit Gulch. We trapped at Summit Gulch in May, but it was prior to having protocols and materials to preserve pellets for this study. The target 15 samples per sampling period was unattainable at Summit Gulch, even after pups had emerged. Trapping at this site has been difficult for several years. Adults and pups are not as vocal as at other sites and trapping success is low. We submitted 55 fecal samples to the University of Washington for analysis (Table 4).

## ASSESSMENT

This pilot effort provided an opportunity to test methods and identify potential problems with the study design. One of the biggest challenges is using Summit Gulch as a study site. Summit Gulch has a long history of NIDGS population monitoring, has an on-going mark-recapture study, and has livestock use that overlaps with the squirrels' active season. However, trapping individuals is difficult and the population appears to be in decline (Evans Mack and Bond 2008). The study design calls for 15 NIDGS fecal samples (i.e., 15 different individuals) in each of 5 months (March – July) each year. In 2008 only 9 individuals were trapped during 2 days in May. In general, the latter 2 sampling periods in June and July should be easier because pups have emerged, but that didn't prove to be the case at Summit in 2008. Lost Valley would make an interesting alternate site if diet alone is the focus. However, if the relationship between NIDGS and livestock is an objective, current livestock use is not coincident with the adult/yearling active season. A more experimental approach would be needed whereby livestock use is manipulated directly.

Extending trapping into July adds risk for adult squirrels. Adults are close to entering hibernation at this time and have put on substantial weight. Males especially are extremely vulnerable to heat stress. We had the first trap mortality in 6 seasons during this pilot study. Live-trapping protocols need to be tightened to account for warmer temperatures, and it may require more days per site if trapping hours are restricted to early morning and late afternoon/evening.

In addition to recording vegetation species at each study site, recording phenology and frequency at the time of fecal sampling puts NIDGS diet in the context of availability and preference. The Daubenmire vegetation sampling we used was a standard approach and relatively straightforward, although more frequent sampling will be required. Daubenmire plot frames were inexpensive and relatively quick. The downside was that the data collected were based on ocular estimates of canopy cover, which was subjective. In this pilot year the same person ran all transects at both sites, minimizing observer bias. Point frames yield similar data but are based on an actual count of 'hits' on the frame, which is less subjective and thus more repeatable. Dr. Yensen suggested replacing plot frames with point frames.

## ACKNOWLEDGMENTS

This pilot study was funded by the Payette National Forest, facilitated by A. Egnew, and U.S. Fish and Wildlife Service Section 6 funding. Dr. E. Yensen developed the study design. A. Hanson and M. Olson, Payette National Forest, and Pat Packard, College of Idaho, assisted with plant identification. J. Prickett was a member of the trapping crew and assisted with plant collection.

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Table 1. Preliminary list of plant species recorded at the Tree Farm and Summit Gulch northern Idaho ground squirrel sites, May – July 2008.

	Tree Farm	Summit Gulch
<b>FORBS</b>		
<i>Achillea lanulosa</i> (yarrow)	X	X
<i>Agastache urticiflora</i> (nettleleaf horsemint)	X	
<i>Agoseris</i> sp. (false dandelion)	X	X
<i>Allium acuminatum</i> ? (hooker's onion)	X	X
<i>Allium</i> sp	X	X
<i>Allium tolmei</i> (Tolmei's onion)		X
<i>Antennaria</i> spp. (pussytoes)	X	X
<i>Arabis</i> sp. (rock cress)	X	X
<i>Arnica cordifolia</i> (heart-leaved arnica)	X	X
<i>Arnica sororia</i> (twin arnica)	X	X
<i>Balsamorhiza sagittata</i> (arrow-leaved balsamroot)	X	X
<i>Besseyia rubra</i>	X	X
<i>Brodiaea douglasii</i> (hyacinth)	X	X
<i>Calochortus nuttallii</i> (sego lily)	X	X
<i>Camassia quamash</i> (camas)	X	X
<i>Camissonia subcaulis</i> - <i>Oenothera</i> sp (evening primrose)	X	X
<i>Capsella bursa-pastoris</i> (shepard's purse)	X	
<i>Castilleja flava</i> (yellow paintbrush)	X	
<i>Cirsium arvensis</i> (canada thistle)	X	X
<i>Claytonia lanceolata</i> (spring beauty)	X	X
<i>Clematis hirsutissima</i> (sugar bowl)	X	X
<i>Collinsia parviflora</i> (blue-eyed mary)	X	X
<i>Collomia linearis</i> (narrow leaved collomia)	X	X
<i>Crepis</i> sp. (hawksbeard)	X	X
Cusick's Pea vine (white pea)	X	
<i>Cynoglossum officinale</i> (houndstongue)	X	X
<i>Cystopteris fragilis</i> (brittle bladderfern)	X	
<i>Delphinium bicolor</i> (larkspur-small)	X	
<i>Delphinium nuttallianum</i> (larkspur-tall)	X	X
<i>Descurainia richardsonii</i> ? (tansy-mustard)	X	
<i>Dodecatheon jeffreyi</i> (shooting star)	X	
<i>Erigeron</i> sp. (fleabane-purple)	X	X
<i>Eriogonum heracleoides</i> (umbrella buckwheat)	X	X
<i>Eriogonum</i> sp. (mat forming (cushion?) buckwheat)	X	
<i>Erythronium grandiflorum</i> (glacier lily)	X	X
<i>Fragaria virginiana</i> (strawberry)	X	X
<i>Frasera albicaulis</i> ( <i>gentian</i> )	X	X
<i>Fritillary pudica</i> (yellow bells)	X	
<i>Galium</i> sp. (bedstraw)	X	X
<i>Geranium viscosissimum</i> (sticky purple geranium)	X	X
<i>Geranium</i> ? <i>Delphinium</i> ?	X	X

Table 1, con't. Preliminary list of plant species recorded at the Tree Farm and Summit Gulch northern Idaho ground squirrel sites, May – July 2008.

	Tree Farm	Summit Gulch
<i>Geum triflorum</i> (prairie smoke)	X	X
<i>Hackelia floribunda</i> (many flowered stickseed)	X	X
<i>Heracium albertinum</i> (hawkweed)	X	X
<i>Hesperochiron pumilus</i> (dwarf hesperochiron)	X	X
<i>Hydrophyllum capitatum</i> (ballhead waterleaf)	X	X
<i>Ipomopsis aggregata</i> (scarlet gilia)	X	X
<i>Lappula redowskii</i> (Western Stickseed)	X	X
<i>Lathyrus</i> sp	X	X
<i>Lepidium campestre</i> (peppergrass)	X	
<i>Lithophragma bulbifera</i> (starflower)	X	X
<i>Lithophragma parviflora</i> (starflower)	X	X
<i>Lithospermum ruberale</i> (stoneseed)	X	
<i>Lomatium grayi</i> (desert parsley)	X	X
<i>Lomatium nubicale</i> (biscuitroot)	X	X
<i>Lomatium triternatum</i> (nine-leaved desert parsley)	X	X
<i>Lupinus caudatus</i> (lupine-purple blooms)	X	X
<i>Lupinus sericeus</i> (lupine-fuzzy)	X	X
<i>Madia glomerata</i> (mountain tarweed)	X	
<i>Mertensia longiflora</i> (bluebells)	X	X
<i>Microsteris gracilis</i> (pink twink)	X	X
<i>Montia perfoliata</i> (Miner's lettuce)	X	X
<i>Nemophila breviflora</i> ? (nemophila)	X	X
<i>Orthocarpus</i> ? <i>Ipomopsis</i> ?	X	
<i>Paeonia brownii</i> (peony)	X	X
<i>Penstemon gairdneri</i> (penstemon)	X	
<i>Penstemon globosus</i> or <i>procerus</i> (penstemon)	X	X
<i>Phacelia hastata</i> (white-leaved phacelia)	X	X
<i>Polygonum</i> sp. (knotweed)	X	X
<i>Potentilla glandulosa</i> (sticky cinquefoil)	X	X
<i>Potentilla gracilis</i> (slender cinquefoil)	X	X
<i>Primula cusickiana</i> (Cusicks primrose)	X	
<i>Prunella vulgaris</i> (self-heal)	X	
<i>Ranunculus glaberimus</i> (sagebrush buttercup)	X	
<i>Ranunculus uncinatus</i> (buttercup-tall)	X	
<i>Rumex acetosella</i> (sheep sorrel)		X
<i>Sanguisorba annua</i> (prairie burnet)	X	
<i>Saxifrage integrefolia</i> ? (saxifrage)	X	X
<i>Sedum stenopetalum</i> (stonecrop)	X	X
<i>Senecio integerrimus</i> (groundsel)	X	X
<i>Senecio</i> sp (butterweed)	X	X
<i>Sidalcea oregana</i> (checker mallow)	X	X
<i>Sisyrinchium inflatum</i> (grass widow)	X	X

Table 1, con't. Preliminary list of plant species recorded at the Tree Farm and Summit Gulch northern Idaho ground squirrel sites, May – July 2008.

	Tree Farm	Summit Gulch
Taraxacum officinale (dandelion)	X	X
Thalictrum occidentale (meadow rue)	X	
Tragopogon dubius (yellow salsify)	X	X
Trifolium sp.		X
Trifolium sp.		X
Trifolium sp.		X
Trillium petiolatum (purple trillium)	X	
Urtica dioica (stinging nettle)	X	
Veratrum californicum or viride (hellebore)	X	
Verbascum thapsus (mullein)	X	X
Vicia	X	X
Viola adunca (lavender violet w/spur)	X	X
Viola nuttallii (yellow violet)	X	X
Wyethia helianthoides (white wyethia)	X	X
Zygadenus venenosus (death camas)	X	X
UNKNOWN <i>composite - big dandelion leaf</i>	X	
UNKNOWN <i>composite thick leaf long narrow at end, base-wide</i>		X
UNKNOWN <i>forgetmenot/paintbrush type</i>	X	
UNKNOWN <i>lance leaf grows in bunches</i>	X	
UNKNOWN <i>lance leaved w/red tinge</i>	X	
UNKNOWN <i>low lance-leaved</i>	X	
UNKNOWN <i>raddish leather leaf purple stem</i>	X	
UNKNOWN <i>short lanceolate yellow green</i>	X	
UNKNOWN <i>yellow spores underneath leaf</i>	X	X
<b>SHRUBS</b>		
Amelanchier alnifolia (serviceberry)	X	X
Atremesia spp. (sagebrush)	X	X
Rosa woodsii (wild rose)	X	X
Crataegus douglasii (black hawthorn)	X	X
Symphoricarpos albus (snowberry)	X	X
Ribes cereum (squaw currant)	X	
<b>GRAMINOIDS</b>		
sedge (big one)	X	
sedge (bright green)	X	
tall grass (gray)	X	
bunch grass (short)	X	
tall grass (not gray)	X	
grass open seed flwr head (poa)	X	
"orchard" grass - thick leaved	X	

Table 1, con't. Preliminary list of plant species recorded at the Tree Farm and Summit Gulch northern Idaho ground squirrel sites, May – July 2008.

	Tree Farm	Summit Gulch
4 more grasses	X	
bunchgrass	X	
grass	X	
rush	X	
#1 A spic? Squirrel tail?		X
#2 Poa 1		X
#3 Agrostis stolonifera?		X
#4 brome?		X
#5 long awned grass		X
#6 Idaho fescue - (but it is not)		X
#7 small gone to seed grass		X
#8 grass basal leaf close to stem		X
#9 tight head leaves turned out yellow green		X
# 10 cheat grass?		X
#11 bluish bunch grass long panicle few spikelets		X
#12 elk sedge/pine grass		X
#13 kentucky blue grass? 2 sided stem		X
right angle grass	X	
small grass big spikelet	X	



Table 2. Site-level summary across 4 Daubenmire vegetation transects (40 frames) at Tree Farm, 10 June 2008. Species are listed in order of frequency of encounter.

Species	Total Canopy <sup>a</sup>	Species Composition <sup>b</sup>	Frequency <sup>c</sup>
<i>Itty bitty unknown</i>	197.5	18	98
<i>Yarrow</i>	125	12	40
<i>Cinquefoil (P. gracilis)</i>	60	6	23
<i>Larkspur</i>	22.5	2	23
<i>Buckwheat</i>	130	12	20
<i>Pussytoes</i>	55	5	18
<i>Wetland scenecio</i>	87.5	8	15
<i>Blue-eyed Mary</i>	40	4	15
<i>Lomatium (bisquitroot)</i>	40	4	15
<i>Strawberry</i>	40	4	15
<i>Nine-leaved lomatium</i>	15	0	15
<i>Saxifrage (alum root)</i>	12.5	0	13
<i>Geranium</i>	35	3	10
<i>Sedum (stonecrop)</i>	10	0	10
<i>Snowberry</i>	55	5	8
<i>Sagebrush</i>	32.5	3	8
<i>Sticky Cinquefoil</i>	20	2	8
<i>Dandelion</i>	7.5	0	8
<i>Onion (small)</i>	7.5	0	8
<i>Parsley sp.</i>	7.5	0	8
<i>Starflower</i>	7.5	0	8
<i>Yellow Violet</i>	7.5	0	8
<i>White wyethia</i>	52.5	5	5
<i>Groundsel</i>	30	3	5
<i>Sticky Current</i>	30	3	5
<i>Fleabane</i>	5	0	5
<i>Grass Widow</i>	5	0	5
<i>Hawkweed (Agoseris)</i>	5	0	5
<i>Bedstraw</i>	2.5	0	3
<i>Camas</i>	2.5	0	3
<i>Evening Primrose</i>	2.5	0	3
<i>Peavine</i>	2.5	0	3
<i>Primrose (purple)</i>	2.5	0	3
<i>Thistle</i>	2.5	0	3
<i>Wetland hawkweed</i>	2.5	0	3

<sup>a</sup> Total canopy = (sum of [# of quadrats in cover classes x midpoint of cover class for each of 6 cover classes])/total # quadrats sampled

<sup>b</sup> Species composition = percent canopy cover of species/ total canopy cover of all species

<sup>c</sup> Frequency = # of quadrats in which species is observed/total # quadrats sampled

Table 3. Site-level summary across 5 Daubenmire vegetation transects (50 frames) at Summit Gulch, 23 and 24 June 2008. Species are listed in order of frequency of encounter.

Species	Total Canopy <sup>a</sup>	Species Composition <sup>b</sup>	Frequency <sup>c</sup>
<i>Collomia &amp; Microsteris</i>	322.5	7	78
<i>Unknown Grass</i>	395	9	36
<i>Buckwheat</i>	647.5	15	34
<i>Yarrow</i>	297.5	7	34
<i>Poa 1</i>	230	5	32
<i>White Wyethia</i>	147.5	5	30
<i>Blue-eyed Mary</i>	92.5	2	26
<i>A. stolonifera</i>	197.5	5	24
<i>Unknown Itty Bitties</i>	87.5	2	22
<i>Snowberry</i>	170	4	20
<i>Mini Jacob's Ladder</i>	100	2	20
<i>Lupine (non-fuzzy)</i>	347.5	8	18
<i>Heartleaf arnica</i>	115	3	16
<i>Knotweed</i>	32.5	1	16
<i>Yellow Violet</i>	17.5	0	14
<i>Prairie Smoke</i>	345	8	12
<i>Miner's Lettuce</i>	27.5	1	12
<i>Cinquefoil (P. Gracilis)</i>	110	3	10
<i>Peavine - long narrow leaf</i>	25	1	10
<i>Strawberry</i>	37.5	1	10
<i>Groundsel</i>	35	1	8
<i>Pussytoes</i>	45	1	6
<i>Dandelion</i>	45	1	6
<i>Tight head</i>	42.5	1	6
<i>Onion</i>	7.5	0	6
<i>Sego Lily</i>	7.5	0	6
<i>Geranium</i>	100	2	4
<i>Wild Peony</i>	30	1	4
<i>Fuzzy Lupine</i>	52.5	1	4
<i>Penstemon spp.</i>	30	1	4
<i>Alumroot</i>	30	1	4
<i>Lomatium - Bisquitroot</i>	5	0	4
<i>Goatsbeard</i>	5	0	4
<i>Wild Rose</i>	17.5	0	4
<i>Stonecrop</i>	5	0	4
<i>Lomatium - 9 Leaf</i>	5	0	4
<i>Death camas</i>	5	0	4
<i>Ballhead waterleaf</i>	17.5	0	4
<i>Squirrel tail A. spic</i>	37.5	1	2
<i>Wetland senecio</i>	15	0	2
<i>Shooting star</i>	15	0	2

Table 3, con't. Site-level summary across 5 Daubenmire vegetation transects (50 frames) at Summit Gulch, 23 and 24 June 2008.

Species	Total Canopy	Species Composition	Frequency
<i>Yellow spore</i>	2.5	0	2
<i>Clover</i>	15	0	2
<i>Black hawthorn</i>	15	0	2
<i>Spring beauty</i>	2.5	0	2
<i>Bedstraw</i>	2.5	0	2
<i>Cerceum - thistle like</i>	2.5	0	2

<sup>a</sup> Total canopy = (sum of [# of quadrats in cover classes x midpoint of cover class for each of 6 cover classes])/total # quadrats sampled

<sup>b</sup> Species composition = percent canopy cover of species/ total canopy cover of all species

<sup>c</sup> Frequency = # of quadrats in which species is observed/total # quadrats sampled

Table 4. Number of fecal samples collected May-July 2008 for diet analysis from Tree Farm and Summit Gulch northern Idaho ground squirrel sites.

	NIDGS	Cow
<b>May</b>		
Tree Farm (5/21, 5/23)	12	
<b>June</b>		
Summit Gulch (6/13)	3	
<b>July</b>		
Tree Farm (7/14, 7/16)	12	10
Summit Gulch (7/22, 7/23)	8	10
<b>Total</b>	35	20